

HYPOP Overview

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HYPOP is a hybrid vertical coordinate version of the Los Alamos global ocean code POP. Advantages offered by hybrid vertical coordinates include (1) a nearly isopycnal treatment of the deep ocean and elimination of the spurious vertical mixing inherent in z-level models and (2) high resolution time-dependent treatment of the ocean mixed layer using nearly horizontal grid layers.

Some of the main features of HYPOP include

- Layer thickness may vary in space and time with few constraints. Vertical grid motion/fluxing is achieved via a conservative remapping scheme using cubic splines.
- Lateral discretization is based on the C-grid (velocities at centers of lateral cell faces, tracers at cell centers, pressures at centers of top and bottom cell faces).
- A second-order forward-staggered time stepping scheme is employed for advancing the barotropic equations and a subcyclong strategy for advancing the baroclinic equations.
- Splitting of barotropic and baroclinic modes is based on the principles that (1) the baroclinic mode should have no dynamics arising from the pressure gradient term when the density is uniform and (2) the baroclinic layer fluxes should make no net contribution to the vertical mean flux.
- For mass and tracer transport we use a conservative second-order accurate split 1-D incremental remapping approach. Gradients are limited to provide positivity for mass transport and monotonicity for tracer transport.
- We use a quadratic representation of bottom topography within each cell to minimize the spurious imbalance in the pressure gradient and gravitational forces along lateral coordinate surfaces that can become extreme in a stepped topography approach when cell mass becomes very small.

Our near-term goals include completing some details relating to the lateral transport scheme, validating HYPOP in Eulerian limit by comparing with POP and in Lagrangian limit by comparing with MICOM, validating the adaptive aspects of vertical coordinate scheme, and completing development of a new geodesic version of HYPOP.